

## Accepted Manuscript

Threshold incomplete factorization constraint preconditioners for saddle-point matrices

Sangye Lungten, Wil H.A. Schilders, Joseph M.L. Maubach

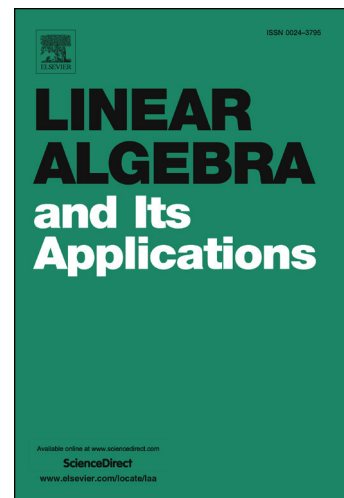
PII: S0024-3795(18)30048-X  
DOI: <https://doi.org/10.1016/j.laa.2018.01.034>  
Reference: LAA 14458

To appear in: *Linear Algebra and its Applications*

Received date: 1 June 2017  
Accepted date: 25 January 2018

Please cite this article in press as: S. Lungten et al., Threshold incomplete factorization constraint preconditioners for saddle-point matrices, *Linear Algebra Appl.* (2018), <https://doi.org/10.1016/j.laa.2018.01.034>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# Threshold incomplete factorization constraint preconditioners for saddle-point matrices<sup>☆</sup>

Sangye Lungten<sup>a,\*</sup>, Wil H.A. Schilders<sup>a</sup>, Joseph M.L. Maubach<sup>a</sup>

<sup>a</sup>*Centre for Analysis, Scientific Computing and Applications, Department of Mathematics and Computer Science, Eindhoven University of Technology, 5600 MB, Eindhoven, The Netherlands*

---

## Abstract

This paper presents a drop-threshold incomplete  $LD^{-1}L^T(\delta)$  factorization constraint preconditioner for saddle-point systems using a threshold parameter  $\delta$ . A transformed saddle-point matrix is partitioned into a block structure with blocks of order 1 and 2 constituting ‘a priori pivots’. Based on these pivots an incomplete  $LD^{-1}L^T(\delta)$  factorization constraint preconditioner is computed that approaches an exact form as  $\delta$  approaches zero. We prove that both the exact and incomplete factorizations exist such that the entries of the constraint block remain unaltered in the triangular factors. Numerical results are presented for validation.

*Keywords:* Saddle-point matrices, Transformation, Incomplete factorization, Constraint preconditioner

*MSC:* 15A23, 65F05, 65F50

---

## 1. Introduction

We focus on sparse and large saddle-point systems

$$\begin{aligned} \mathcal{M}u &= b, \\ \text{with } \mathcal{M} = \mathcal{M}(A) &= \begin{bmatrix} A & B^T \\ B & 0 \end{bmatrix}, \quad u = \begin{bmatrix} x \\ y \end{bmatrix}, \quad b = \begin{bmatrix} f \\ g \end{bmatrix}, \end{aligned} \tag{1}$$

where  $A \in \mathbb{R}^{n \times n}$  is a symmetric positive definite (SPD) matrix,  $B \in \mathbb{R}^{m \times n}$  (with  $m < n$ ) is a constraint matrix of full rank, and the vectors  $x, f \in \mathbb{R}^n$ , and  $y, g \in \mathbb{R}^m$ . Such systems originate for instance from constrained optimization problems [52, pp. 137–276], discretization of Stokes equations [50] and Maxwell equations [53], and network analysis in electronic circuits [54] and water distribution systems [55].

---

<sup>☆</sup>This work was supported by the Erasmus Mundus IDEAS project.

\*Corresponding author

*Email addresses:* [s.lungten@tue.nl](mailto:s.lungten@tue.nl) (Sangye Lungten), [w.h.a.schilders@tue.nl](mailto:w.h.a.schilders@tue.nl) (Wil H.A. Schilders), [J.M.L.Maubach@tue.nl](mailto:J.M.L.Maubach@tue.nl) (Joseph M.L. Maubach)

Download English Version:

<https://daneshyari.com/en/article/8897910>

Download Persian Version:

<https://daneshyari.com/article/8897910>

[Daneshyari.com](https://daneshyari.com)